HIGHER-ORDER MATCHING FOR HEAVY QUARKS IN PERTURBATIVE QCD

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Treatment of heavy quarks

- Crucial for a precise description of phenomenology
- Main problem: different schemes of renormalization and factorization

DECOUPLING SCHEME: **3FS**

- the heavy mass is kept
- the heavy quark decouples from the α and DGLAP evolutions
- logs present up to a finite order

$\overline{MS}$ SCHEME: **4FS**

- the heavy mass is neglected
- the heavy quark contribution is present at all scales
- log terms resummed up to a logarithmic accuracy

Fixed-Order Next-to-Leading Log Approach

It provides a general framework for the inclusion of heavy quark mass contributions to DIS structure functions.

$$F(Q) = F^{(4)}(Q) + F^{(3)}(Q) - F^{(3,0)}(Q) \tag{1}$$

- Massive scheme $\rightarrow$ fixed-order accuracy
- Massless scheme $\rightarrow$ logarithmic accuracy

Matching at N3LO

$$\alpha_s^{(n_l+1)}(Q^2) = \alpha_s^{(n_l)}(Q^2) + \sum_{i=2}^{\infty} c_i(L) \times \left(\alpha_s^{(n_l)}(m^2)\right)^i$$

$$f_i^{(n_l+1)}(Q^2) = \int_x^1 \frac{dy}{y} \sum_{j=q,\bar{q},g} K_{ij}\left(\frac{x}{y}, L, \alpha_s^{(n_l)}(Q^2)\right) f_j^{(n_l)}(y, Q^2)$$

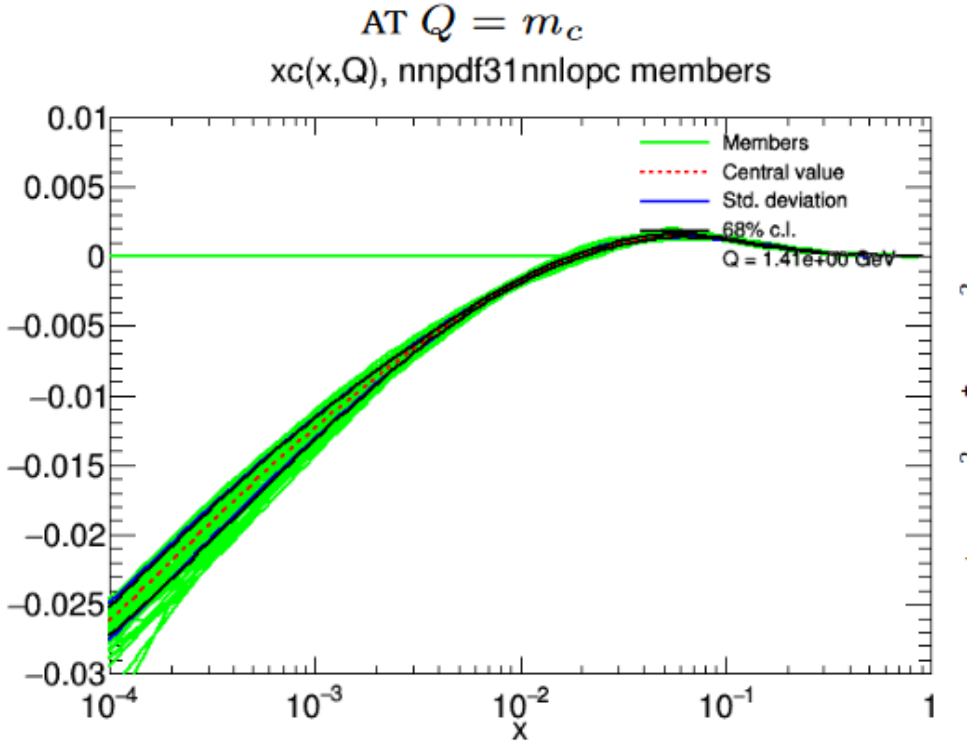
- All the equations expanded up to α_s^3 (absolute ordering) $\rightarrow$ new frontier for high precision calculations
- Explicit expressions for DIS structure functions but most of the massive Wilson coefficients are known in the asymptotic region only $\rightarrow$ future perspective

The charm as the single heavy quark

Fully perturbative charm :

$$f_h^4(Q) = A_{Qq}^{PS} \otimes \Sigma^3(Q) + A_{Qg} \otimes f_g^3(Q)$$

- O(α_s): f_h=0
- O(α_s^2): non-trivial but, in fact, LO
- O(α_s^3): first non-trivial correction



Intrinsic and perturbative charm

The intrinsic component is still an open question. Main goal of this project: compare a α_s^3 perturbative charm with a fitted charm